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The MONTHLY REVIEW

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article on Stripping

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OF THE
SCIENCE OF ELECTROPLATING

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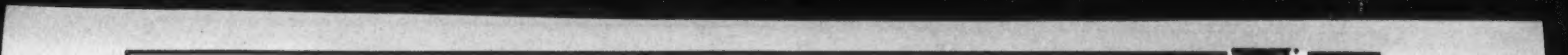

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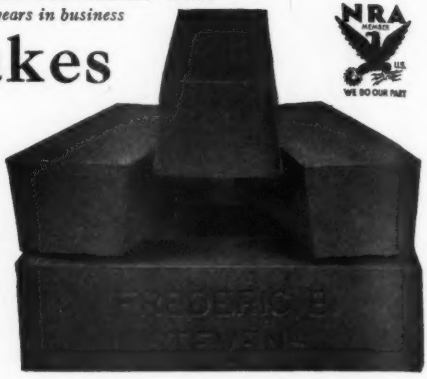

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MONTHLY REVIEW

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EDITORIAL

N.R.A. and the Electro-Plating Industry

F. F. Pierdon
Baltimore-Washington Branch

The general purposes of the N.R.A. are well known. This article is a brief summary of the steps that have been taken that may affect the plating, polishing and rust-proofing industries, and the activities that are necessary for a completion of this program.

Even though the American Electro-Platers' Society is not in a position to officially discuss such questions as hours and wages, it is the logical organization to propose standards of quality that may be incorporated into the codes. It is important therefore for all members of the A.E.S. to become familiar with the plans of the N.R.A.

This field comes under the immediate supervision of Major J.A. Hillman, of the Division of Control. Soon after the N.R.A. plans were announced, codes for the plating industry were proposed by Master Platers' Institute, Richard Nagle, Secretary, 3835 Seiss Avenue, Toledo, Ohio, Chromium Platers' Guild of America, Philip Sievering, Secretary, 199 Lafayette St., New York; Association of Electroplaters' of Southern California, G. W. Kyle, Secretary, 1151 South Broadway, Los Angeles, Calif; The Plating, Rust Proofing and Enameling Association of Michigan, Douglas O. Crane, Secretary, 2415 Darlum Tower, Detroit, Michigan. In addition to considering these codes, the N.R.A. officials conferred informally with job platers of Baltimore and Washington, including the author of this report.

It soon became apparent that no present organization fully represents the job plating industry, a primary requirement in

the preparation of such codes. Before a detailed code for the plating industry can be adopted, it is necessary to form some organization or group that will be able to speak for the whole industry. All interested persons are therefore urged to join some such body and to urge cooperation or consolidation of the various agencies.

In the meantime it may be possible to adopt a basic code, which will be similar to that for related industries. At present it is proposed to apply to the job plating industry the code which has been proposed for the Fabricated Metal Products Industry.

This will still permit the adoption of a supplementary code for job plating where this industry is sufficiently organized.

In order to assist in bringing about this agreement the Author will be glad to send to any interested persons or organizations, without charge, any government publications that are available and transcripts of discussions, for which the official charge is 2c per page. Please send such requests to F. F. Pierdon, 923 - 12th Street, N. W. Washington, D. C.

Substantial progress has been made and if those interested will cooperate fully a code can be prepared which will serve the purposes of the N.R.A. and be of great value to the job plating industry.

TO ALL OUR BRANCHES

It is important that all our branches vote at the earliest possible time on the dates June 11, 12, 13, 14 proposed by the Detroit Branch to hold the 1934 Convention. Notify Secretary Gilbertson when the vote is taken.

WHY NOT?

In traveling around the industrial plants, we come in contact with a number of men, high class men, who have devoted all their lives to the finishing business. They are men who have to spray lacquer on plated finishes and have to do Japan work after the material has been prepared by the plater. There are a large number of finishers who do not know how to plate, but who know the art of finishing in other forms, including gilding, mask work, graining and blending. They are men who can make a plated job look better, men who take pride in doing good work, and men who could be a big help to the Electro-Platers Association. They would add a new enthusiasm to the association and increase its membership a great deal.

So far I have been unable to discover any association of finishers but they will have one some day, if they haven't one already. Why not have a drive to see if we can get some of them to join our organization, for the finisher has to work hand and glove with the plater. Why not?

I would like to hear what some of the other members have to say on this subject.

E. M. STEPHENSON
Member Hartford-Conn. Valley Branch

METHODS OF STRIPPING PLATED COATINGS

A. Brenner (Read by Dr. William Blum)

Read at Chicago Convention 1933

I. INTRODUCTION

This investigation includes studies of the removal of plated coatings for analytical purposes and for replating. These processes may be designated respectively as (a) analytical stripping and (b) commercial stripping. This progress report is confined to the consideration of the removal of nickel, copper and chromium from steel or from each other. Further studies will include stripping of these coatings from other base metals, and also stripping of zinc and cadmium from steel.

II. GENERAL PRINCIPLES

It is expected that the exposure tests now in progress will furnish information that may serve as a basis for specifications for plated coatings. If such specifications involve the thickness of the deposits, it is necessary to have simple reliable methods of determining the thickness. For most purposes the average thickness is specified. This can be most readily ascertained by dissolving the coating, determining its weight, and calculating the thickness from the measured area of the piece. The ideal stripping method is one in which only the coating is dissolved, so that its weight is equal to the loss in weight of the object. In the absence of such a method, it is necessary to dissolve the coating along with some of the base metal, and determine the weight of the coating by analyzing the resulting solution.

When there is only one metal layer on the base metal it is necessary merely to find a reagent and conditions that will dissolve the coating in a moderate time, without attacking the base metal to the extent of more than a few per cent of the weight of the coating. As will be shown, this can usually be accomplished. If, however, as is frequently the case, the coating contains three

or more layers of different metals, it is desirable but difficult to dissolve the metals successively. This difficulty arises from the fact that plated coatings are rarely impervious. Hence a reagent that will dissolve metal "a", but not the next layer "b", may get access to layer "c" that is under "b". With coatings of good quality this difficulty may not be great, but with very thin and porous coatings it is serious.

It is often necessary to remove plated coatings prior to the replating of defective or worn articles. For this purpose a slight attack of the base metal is not objectionable, provided that pitting does not occur. The cost of reagents and the time required are more important for such stripping than for analytical purposes.

III. RESULTS FROM EXPERIMENTS

1—Nickel from Steel:

(a) Reversed current in sulphuric acid. Nickel becomes passive and dissolves very slowly with reversed current in concentrated sulphuric acid. This passivity is accompanied by a visible film of anhydrous sulphate on the anode surface. If the acid is diluted, the nickel dissolves more rapidly, but the steel is then also attacked. The best results were obtained in 70 per cent acid (made by mixing 13 volumes of concentrated sulphuric acid and 9 volumes of water). An anode current density of not more than 20 amp/sq. ft. (2 amp/dm^2) should be used. At best the steel is somewhat attacked, so the method is not suitable for a weight determination. The tendency toward pitting can be reduced by the addition of 2 oz/gal (15 g/l) of glycerin.

(b) Reversed current in a cyanide solution. This is not very satisfactory because the last part of the nickel is difficult to remove. With a solution containing 27 oz/gal(200 g/l) of sodium cyanide at 160 degrees Fahrenheit (70 degrees Centigrade), and a current density of 20 amp/sq. ft. (2 amp/dm^2) the nickel was removed from about half the surface in a short time, but it required nearly a day to remove all of it.

(c) Immersion in nitric acid. Concentrated nitric acid dissolves nickel so slowly (about 0.001 inch in 6 hours) that it is not good for commercial stripping, though useful for analysis. For the latter purpose the concentrated C. P. acid (68-70 per cent) should be used. When the nickel is all dissolved, the article should be rinsed quickly and thoroughly to prevent solution of the steel by the diluted acid. If the article has a complicated

shape so that it it difficult to rinse, it may be dipped in a twenty-five per cent solution of chromic acid before rinsing in water. The accuracy of the nickel determination by loss in weight is within two per cent.

The method may be used to strip composite coatings of nickel-copper-nickel from steel, but not coatings with copper next to the steel.

(d) Immersion in mixtures of nitric and sulphuric acid. The following mixture is typical of those recommended in the literature:

Sulphuric acid (60 degrees Be′)	4000 ml
Nitric acid (40 degrees Be′)	500 ml
Potassium nitrate	50 g
Water	500 ml

This reagent is unsatisfactory. It dissolves the nickel as slowly as does nitric acid, and attacks the steel as much as does the reversed current in sulphuric acid.

(e) Reversed current in sodium nitrate. The best method found for stripping nickel from steel, either for replating or analysis, was with reversed current in hot sodium nitrate solution. A concentration of 3 lb/gal (360 g/l) is sufficient, but higher concentrations permit higher current densities and more rapid stripping. The solution is heated to about 200 degrees Fahrenheit (90 degrees Centigrade). An anode current density of 100 amp/sq. ft. (10 amp/dm^2) should be used in the above solution, while 300 amp/sq. ft. (30 amp/dm^2) may be used in a solution containing 6 lb/gal (720 g/l) of sodium nitrate. The solution is used in an iron container which also serves as a cathode.

Under these conditions nickel is dissolved rapidly, generally in about one-third the time required for plating. Copper also dissolves, so that composite coatings are completely removed from the steel. The latter is practically unattacked, although case-hardened steel is slightly etched.

This stripping solution gradually becomes alkaline, and basic compounds of nickel (and copper) precipitate. Nitrates also form in it. To keep it effective the solution should be kept nearly neutral by occasional additions of nitric acid. (As this acidifying evolves oxides of nitrogen, the tank should be ventilated). The pH is not critical, and can be regulated by keeping the solution acid (colorless) to phenolphthalein and alkaline (yellow) to methyl red. Chlorides should be absent as they cause the steel to be attacked.

2 — Copper from Steel or Nickel:

For replating, it is desirable to strip composite coatings in one operation. For testing, however, it is preferable to remove the layers consecutively. For example, the nickel may be removed by reversed current in sulphuric acid, after which the under layer of copper is removed from the steel (or from an initial nickel layer).

(a) Immersion in acidified chromic acid. A solution containing 4 lb/gal (500 g/l) of chromic acid and 7 oz/gal (50 g/l) of sulphuric acid dissolves copper rapidly without attacking steel or nickel. For example, it removes 0.0005 inch of copper in 10 minutes with an error of less than one per cent. When the solvent action decreases, more sulphuric acid may be added, but the total concentration of free sulphuric acid should not greatly exceed 50 g/l, as then the steel is attacked.

(b) Reversed current in chromic acid. Copper dissolves anodically in a solution containing 33 oz/ga (250 g/l) of chromic acid, and an anode current density of 50 amp/sq.ft. (5 amp./dm_2).

(c) Reversed current in sodium nitrate. Copper can be dissolved by reversed current in a solution containing 24 oz/gal (180 g/l) of sodium nitrate at room temperature. Under these conditions the steel is unaffected but nickel is slightly attacked.

3 — Chromium from Steel or Nickel:

(a) Immersion in dilute hydrochloric acid. Concentrated hydrochloric acid diluted with ten volumes of water rapidly dissolves chromium from nickel at 120 degrees Fahrenheit (50 degrees Centigrade), with an error of less than three per cent for thin chromium coatings. It is not applicable for stripping chromium from steel or from steel plated with a thin (and porous) nickel deposit.

(b) Reversed current in sodium hydroxide. Chromium is quantitatively dissolved from nickel or steel by a reversed current in a solution containing about 12 oz/gal (90 g/l) of sodium hydroxide.

(c) Reversed current in sodium carbonate. In a solution containing about 16 oz/gal (120 g/l) of sodium carbonate, a reversed current dissolves the chromium, but more slowly than in sodium hydroxide. This method is useful for stripping chromium from nickel on zinc-base die castings, or when there is a layer of zinc or cadmium under the chromium or the nickel. Zinc and cadmium are not appreciably attacked in sodium carbonate soln.

CHAIRMAN SLATTERY: If there are any questions on Mr. Brenner's paper, I am sure Dr. Blum will be pleased to answer them.

MR. HOGABOOM: It is strange how things get hidden. After the work of Dr. Burgess put that in and sent out some of their old catalogs and it is in books on using sodium nitrate or acid sodium sulphate for the stripping. Burgess developed it.

DR. BLUM: Has it been used for stripping nickel?

MR. HOGABOOM: Yes. It is used quite extensively. We have been doing considerable work on stripping deposits on account of the requirements that are being demanded, and we have struck on two simple methods which have given us very good results. One suggested to us was that of stripping nickel from steel direct. It does not affect the steel. We have made a great many experiments and we can find there was no attack on the steel at all. We can remove the nickel in a very few seconds in fuming nitric acid. That will take the copper and the nickel-copper-nickel, so that you can remove those coatings readily in fuming nitric acid. For stripping copper deposits we used cyanide to which we add hydrogen peroxide. Cyanide strip is slow. The addition of hydrogen peroxide accelerates the action; you can remove it in a short time by the addition of hydrogen peroxide to the cyanide solution. There is no effect on the steel at all, so that it can be determined directly by weight. One of our men at the laboratory has devised what I think is an exceedingly unique way of measuring surface areas. It may be used by a number of you, but we have not seen it before. He takes a piece of this paper for plotting curves which have definite squares divided into a large number of smaller squares and passes that over and counts the number of small squares. In that way he can determine the surface area very rapidly without a complicated measuring of the area with some fine instruments.

DR. BLUM: That point, Mr. Hogaboom brings out, is an essential part of the stripping method for analytical purposes, for there is no use in determining the weight of the coating unless you have some means of estimating the area, if the thickness is specified. We know from our experience with teaspoons, forks, knives, and that sort of thing that it is very difficult to measure those areas with high accuracy. I believe that by such methods as Mr. Hogaboom has suggested, simply by methods of adaptation, you can get them within ten per cent, but I would

hate to say that any of those areas could be measured very accurately.

MR. HOGABOOM: It works easily anyway, and you can use a solution over several times if you wish. Of course, a fresh solution works rapidly and is especially good for gold as well as silver. One of the difficulties we had in stripping gold from brass to determine gold was overcome by just using cyanide with the hydrogen peroxide, and our troubles were over.

MR. C. F. NIXON: Does the investigating conducted by the Bureau cover stripping copper from zinc?

DR. BLUM: We have not attempted that so far. The field is enormous, because so far we have worked entirely with steel as the base metal, and this report is confined to copper, nickel and chromium. Regarding work with other base metals, I was trying to recall a method I know Mr. Brenner used in a few experiments which he thought were promising for removing nickel from zinc but I wouldn't want to quote them from memory, because I do not have a record of them. We did not go into stripping copper from zinc.

THE USE OF ACIDS IN THE PREPARATION OF STEEL FOR PLATING

Walter S. Barrows

Read at the Chicago Convention, 1933

Throughout my plating experience of forty years I have been partial to the use of sulphuric acid in the preparation of steel surfaces for plating. I have never encountered a condition of steel, iron or stainless steel which could not be treated successfully by use of sulphuric acid. It is rapid in its action, easily neutralized if the case requires neutralization, it is not unpleasant to use, the surface of a sulphuric acid dip is easily kept clean and if the container is properly supplied with lead draining strips the adjacent fixtures, if any, are not quickly corroded by its fumes.

Many platers and writers of prominence regard sulphuric acid as the logical acid to use prior to nickel plating. On the other hand, many platers of long experience have always given hydrochloric acid preference. If we disregard early training, preferences and much that we read and hear, we must admit that the rapid disastrous rusting of all ferrous metals exposed to air in the vicinity of soldering outfits where zinc chloride is employed, the fouling of all ferrous metal surfaces exposed to contact of ammonium chloride, sodium chloride, etc., is not conducive of

confidence respecting the use of hydrochloric acid prior to plating.

To a young plater who undertakes to launch out into a future of successful adventures in the field of electroplating, the literature of plating is more or less confusing with reference to acid treatment of steel. One author warns his readers against the use of nickel solutions containing chlorides when plating steel or iron, and only a few years ago many platers were strictly following the advice. On the other hand, some authors present formulas, descriptions of methods and outlines of processes, etc., in which the use of hydrochloric acid is not only suggested by actually indicated or given preference.

For years a large percentage of the nickel plating baths used for commercial nickel plating have contained chlorides in some form and the results as viewed from various angles have been greatly to the credit of the chloride nickel bath.

If the young plater is satisfied that chloride nickel plating baths are safe to use when plating steel, he may ask, "Does the use of hydrochloric acid as a dip prior to plating create a condition more favorable to rust than does sulphuric acid? A very common answer to that question has been, "I've used it for years and never had any trouble." Although I always preferred sulphuric acid I have never been prejudiced, and early last summer decided to try out a few experiments which might indicate more or less assuringly whether the effect of hydrochloric acid is more liable to prove harmful to an electrodeposited coating than is the effect of sulphuric acid, if each acid is used with a reasonable degree of care.

For the purpose of the experiment approximately fifty pieces of hard cold rolled steel were prepared. Each piece was wired separately, electro-cleaned and plunged directly into a twenty-five per cent (by volume) solution of sulphuric acid, rinsed through running cold water and placed in a solution of sodium cyanide which registered a density of five degrees Baume. Three minutes were allowed to pass before the first piece was taken from the cyanide. As the pieces were taken from the cyanide the subsequent treatment differed. At least twelve series were made and may be indicated as follows:

25% Sulphuric acid, double rinse, nickeled direct.

25% Hydrochloric acid, double rinse, nickeled direct.

25% Hydrochloric acid, rinse, 25% sulphuric acid, double rinse, nickeled direct.

25% Sulphuric acid, rinse, 25% hydrochloric acid, double rinse, nickeled direct.

66 degree Concentrated H_2SO_4 45 seconds, double rinse, nickeled direct.

22 degree Concentrated Hcl 45 seconds, double rinse, nickeled direct.

Copper strike one minute, rinse, 25% H_2SO_4, rinse, nickeled.

Copper strike one minute, rinse, 25% Hc1, rinse, nickeled.

Copper plated three minutes, rinse, cyanide dip, double rinse, nickeled.

10% H_2SO_4, copper plate two minutes, H_2SO_4, rinse omitted, nickeled.

10% Hcl, copper plate two minutes, Hcl, rinse omitted, nickeled.

Electro clean, cold rinse, scoured with pumice, rinsed and nickeled direct.

No consideration was given details of nickel bath condition. All the pieces were nickeled one hour in the same bath and at the same time. The nickel bath was one year old and when prepared the constituents and amounts per gallon were Nickel Sulphate crystals 24oz, Nickel chloride 3oz, Boracic acid (pulverized) 3oz. Nickel anodes were of the 95-97 per cent variety. Temperature of bath = 85 degrees Fahrenheit. Voltage = 1 4/5 volt. Current density = approximately 10 amperes per square foot. Ph of nickel bath = 5.8. No attention was given the chemical equivalent strength of acid dipping solutions, the percentages given were by volume in all instances. Both undiluted acids were heated to 140 degrees Fahrenheit. When the pieces which were transferred directly from the acids to nickel bath were immersed in the bath and connected to the negative rod of the plating tank, violent gassing occurred for several seconds.

Some of the pieces which were not given any finishing treatment such as polishing, tumbling, etc., were quite seriously pitted on one side only when taken from the plating bath. As this particular bath has not produced pitted work, and as all the other pieces plated at the time for this test were not pitted, I am inclined to think the pits were in the steel. All edges of the pieces plated were rough. About fifty per cent of the pieces were three sixteenths of an inch thick and the lap caused by the punching die extended over approximately one-half the thickness. All the pieces were strung on a strong linen cord in such a manner

as to avoid contact one with the other when arranged in a wooden rack built specially for the purpose. All pieces were suspended at the same level, that is, there was no possibility of drip from one specimen falling on another specimen. The rack containing the pieces was placed on the roof of a shed in a residential district of Toronto, Canada, Thursday, August 4, 1932, and was inspected at intervals of one week. The first trace of rust was detected at the end of the third week. A superficial film extended around the edge of some pieces, but it was only upon the half not covered by the lap made by the punching die mentioned previously. As a matter of fact, these pieces were from the series treated with hydrochloric acid and plated direct. Changes in the condition of the surfaces of the various pieces were gradual during the winter months. Mounds of rust have formed over each pit, but the surfaces surrounding the pits remain in good condition. No evidence of blisters is to be found on any of the pieces. After ten and a half months' constant exposure to the elements we now find practically no difference in the condition of the various pieces. If we ignore the pits, which are obviously from the base metal, we may regard all the pieces as in good condition. As we have found no reasonable excuse for condemnation of any particular acid by reason of this simple experiment, may we not profitably give attention to methods employed in the use of acid dips for steel?

ACID DIPS AND METHODS FOR USING

The use of a twenty-five per cent solution sulphuric acid as a dip for steel directly following alkaline cleaning (either with or without electric current) is an old idea. It was used effectively and successfully long before I was initiated into the mysteries of the the science of plating in the early nineties. It has effected marked reduction in time and labor necessary to clean a wide range of products which are plated. It is dependable. It is economical for the manufacturer and a boon to the electroplater. If, however, an operator does not adhere to certain simple rules he is sure to have trouble. An abundance of clean running water and a cyanide bath of ample capacity to accommodate sufficient work to permit the shortest period of immersion to be at least two minutes are essentials which should be given first consideration. Steel which is treated in an acid dip or pickle, swilled in a rinse water which is nearly as dense as the acid, and transferred to

a plating bath to receive a thirty-minute deposit of nickel, with a current density of less than ten amperes per square foot, is not getting a fair start in life as a plated object.

Furthermore, when a piece of steel or iron is removed from the alkaline cleaning bath and intended for plating, the "stop over's" if any, should not be in foul rinse water or in the air, especially after acid treatment.

During the summer months steel parts which have been polished, tumbled or otherwise prepared for plating and subsequently remain in storage in the plating room, often acquire patches of rust which the electric cleaner loosens but does not remove. In such cases the momentary plunge direct from cleaner into warm sulphuric acid removes practically every trace of the rust and permits the usual operations to follow without interruption. Some platers have difficulty when plating malleable iron. The acid plunge removed the difficulty.

I believe it is better practice to acidulate the surface of a copper deposit by use of very dilute hydrochloric acid, if the article is to be plated in a neutral nickel bath, than to use cyanide as the means of removing possible oxides. But if the copper plated object is to be plated in a nickel bath of usual acidity, I prefer cyanide as the final dip before rinsing for immersion in the nickel bath.

Another point: Neutralization of strong acids upon the surface and in the pores of steel or iron can best be effected by use of the cyanide solution. Soda solutions are not reliable. I have seen steel acquire a film of green rust while suspended in a solution which the plater called a neutralizing bath. When certain grades of steel are plunged into a warm 25% solution of sulphuric acid the reaction during immersion in the acid causes liberation of gas which adheres to the surface of the steel through the rinsing operation and during a three minute immersion in the cyanide solution. Usually this condition denotes weak cyanide solution. If the gas is not removed from the steel surfaces before placing in the plating bath, pitting results.

In the use of concentrated sulphuric acid as a dip for hard steel a slight film may be noticeable when the steel is taken from the acid. This film will disappear if the object is allowed to remain suspended in the rinse water for a few seconds only, and then vigorously agitated in the water before transferring to the final rinse.

The ideas briefly mentioned in this paper are not intended for the plater in charge of a large plating plant where work is prepared and plated by means of mechanical devices. The acid dip mentioned and the use of cyanide as indicated is most practical for the plater who either performs the operations or supervises various sections of a relatively small plant. I have omitted reference to the use of the electric current as an aid in acid treatment of steel simply because my contact with platers has caused me to think that the majority of platers adopt new electrical methods rather slowly and as yet my experience with either anodic or cathodic acid treatment has been very disappointing with respect to time and labor saving.

Many splendid effects may be obtained by the use of the electric current, one or two simple chemicals and a little common sense, but perhaps we will take that up at some later date. For the present I want to try to impress the plater who wants a faithful helper and I can suggest nothing better than the sulphuric acid dip described in this paper. I cannot recommend the use of this dip as herein suggested for steel, for treatment of ordinary cast iron. If a dip of this type is employed for cast iron it will be found advantageous to prepare a solution with a lower percentage of sulphuric acid, or if it is necessary to only occasionally use the twent-five per cent solution for cast iron, the casting should be slightly cooled by a very brief immersion in the rinse water. It is also good practice to always agitate the parts vigorously in the cyanide immediately before removal for any subsequent operation.

It may be advisable to state that I use acids freely prior to deposition of thick coatings of copper and nickel and peeling or premature breakdown of the coatings is of rare occurrence. For hardened steel which has been cleaned of scale, we use the concentrated sulphuric acid at a temperature of about one hundred and forty degrees Fahrenheit. If, as in some cases, the acid treatment must be prolonged sufficiently to produce a reddish discoloration of the steel surfaces, suspend the steel in a cyanide solution for a few minutes then acidulate the surfaces before proceeding to the plating bath. Parts which are quite smooth before cyanide heat treatment ordinarily require little if any tumbling, the acid dip cleans the surfaces quickly and thoroughly so that a white nickel finish is easily obtained.

If you are having difficulty with any grade of steel try the sul-

phuric acid plunge direct from the cleaning bath. If you are required to reduce a tap or threaded die, try hot concentrated sulphuric acid and the electric current, you will find you can control the reduction easily and with very little practice produce a really creditable job. By using auxiliary dips various effects can be obtained, particularly on hardened steel surfaces.

CHAIRMAN SLATTERY: Are there any questions on Mr. Barrows' paper? Thank you, Mr. Barrows.

MR. GARTLAND: I would like to ask Mr. Barrows how he handles the small steel parts for barrel plating, especially in nickel, and the method employed and what metal he uses in the baskets.

MR. BARROWS: We use steel baskets which we make from scrap taken from the stamping department, strips from which washers, nuts, or such things, are punched out. The ones we use for barrel work are six inches wide. We make a basket six inches deep and six inches in diameter. We use perforations according to the work for which the baskets are used. If necessary, the work is tumbled in saw dust or shavings, if it requires cleaning, and placed in a cleaning solution made up of any ordinary cleaner, not too strong, and dipped into the twenty-five per cent sulphuric acid rinse and hung in cyanide, sodium cyanide. Then we proceed to get on the next batch. Take the work out of the cyanide and rinse it in two rinses of water and apply the nickel.

MR. SIEVERING: I should like to ask whether he recommends running the basket work from the cyanide rinse or from the acid dip into the rinse and then into the barrel.

MR. BARROWS: In ordinary soft work, I would take it right from the acid dip and give it a double water rinse and then right into the nickel solution. There is no need of going into the cyanide dip at all.

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CADMIUM PLATING ON FULL AUTOMATIC MACHINES

F. L. Greenwald

Read at Chicago Convention 1933

The advent of the all electric Radio and the Electric Refrigerator, some few years ago, made a sudden and large demand for Cadmium Plating. Its silvery white appearance, the ease with which it can be soldered, its protective value upon steel and iron and its throwing power made it particularly desirable on that class of work. Therefore when hundreds of thousands of parts were required daily, ranging in size from small screws to the radio chassis and refrigerator mounting plate, what would be more natural than to turn to automatic machinery to supply this demand.

The majority of the parts that go into a radio or refrigerator are constructed of steel and are plated without any polishing or buffing. Such parts as were made of brass or phosphor Bronze were Cadmium Plated to facilitate soldering and give the assembled piece a uniform appearance.

A machine set up for Cadmium plating steel will plate brass without any difficulty. The proper arrangement of the various tanks and the length of time the work stays in them is usually taken care of by the manufacturers of the machine after they are informed as to what sort of a plate is required and on what kind of metal.

The parts to be plated are sometimes received from several different sources making it a difficult problem to clean successfully, especially so, where no washing operation is used prior to loading on automatic plating machines. In cleaning work for plating or pickling it is well to check up occasionally on the lubricant which is used in stamping or drawing the various parts as well as the lubricants used in machining parts.

At one time we received a run of work from the press room which did not plate properly although run under same conditions as previous parts, and upon investigating we found that the press room had used heavy machine oil, when someone got into the wrong oil drum. On another occasion someone got hold of a can of varnish and applied it to sheet steel which was to be formed. Some of those parts got to the Plating Department and were run through plating machines. Needless to say, they were rejected for poor plating.

It is almost too much to ask a cleaner to remove these materials

without some mechanical action. At times on certain parts, where a deep draw is required, the press room insists it is necessary to use white lead or graphite in oil, either one of which is difficult to clean when putting it directly on an automatic machine. The oil will be removed but the lead and graphite will remain on the metal. Obviously, the way to handle such parts is to run them through a washing machine where they get the spraying action which washes lead and graphite off with mechanical action along with oil. Work can be cleaned economically in a washing machine because a weak cleaning solution can be used and then changed oftener.

Before the days of plating machines, when each job was handled individually, the cleaning job could be done according to its particular needs. With an automatic plating machine, such is not the case; every piece passes through exactly the same treatment, and if everything is in order the work will come out o. k., but if the cleaners, dips and plating solutions are not in condition, you are in for some rejected work. The proper thing to use would be a washing machine to insure uniformly clean work going on the plating machine. But where a washing machine is not available, it is possible to take work just as it comes from the press room, load it directly on the plating machine and still get good results, provided a good electric cleaner is used.

We have operated three full automatic plating machines for several years, handling parts of every shape and size and in almost every condition imaginable, without previous cleaning of any kind. Of course, we have had to carry our electric cleaner stronger than would have been necessary had we used a washing machine. Several cleaners we tried gave us considerable inconvenience by forming a heavy foam which held the generated gasses until a spark from the work carrier would ignite same and cause an explosion. Eventually, we found a cleaner which did a good job and did not form a heavy foam.

The work remains in the electric cleaner three minutes at a current density of thirty amperes per square foot. The 1500 gallon steel tank is used as a cathode and the work as an anode. The reason for the reverse current is that we got a much clearer surface on work. When direct current was used we got a film of tin on work; this tin had been deposited on sides of cleaning tank when we reversed current to back tin off a batch of tin plate. On cleaning tank we have installed a compressed air spray to

keep floating grease and oils away from work when it enters and leaves solution, at the same time it blows steam and fumes toward an exhaust hood placed at other end of tank.

To get full benefits of an automatic plating machine, racks should be used for the various parts to speed up the loading and unloading of machines.

Following the electric cleaner comes a hot water rinse of ten seconds. It is used hot for better rinsing results and also permits work to pass into the pickle in a heated condition helping to keep it at the proper temperature. The 20% muriatic acid pickle, run at a temperature of 120 degrees F. is expected to and does take care of ordinary rust, scale and electric welding spots. Time of pickling is one minute. Capacity of tank is 600 gallons. When we receive a batch of steel that is exceptionally bad due to rust or scale, we have parts pre-pickled before going on the machine. Acid pickle is equipped with compressed air spray same as cleaning tank and for the same purpose. Pickle tanks are rubber lined steel and are heated with steam injected through lead pipe.

We have been unable to obtain a coil that would last a reasonable length of time, so we continue to use a steam jet although it does raise the level of acid until it is necessary to dip it out to keep from running over. This is not such bad practice as it seems for by dipping out part of old solution and adding fresh acid occasionally we avoid recharging entire tank as often as would be necessary if none were removed.

Following the acid pickle is a 750 gallon cold water rinse with water spray playing on work carriers at this point, it being the most convenient place on machine, this washes off any cleaner or pickling acid and helps to keep contacts between carrier and plating racks clean. Length of time in above rinse is one and one-quarter minutes.

On account of parts picking up some grease from acid, a warm sodium cyanide electric cleaner is used just before work enters cadmium plating solution. This cyanide solution contains 5 ounces cyanide per gallon and direct current is used at 20 amperes per square foot for one minute. It is not necessary to rinse parts before going into plating bath as the drag out from cyanide cleaning solution tends to keep up free cyanide content of plating bath and if cyanide cleaner were carried strong enough you could have practically a self-sustaining solution as the anode surface may be controlled so that sufficient metal is dissolved at anodes.

The original plating solution was installed by the Udylite Process Company. The anodes used are ball shaped and are dropped into spiral steel wire containers making it possible to have a constant anode surface by keeping baskets filled and at the same time supply the necessary steel anode surface. At 25 amperes per square foot a nice bright silvery deposit is obtained on a reasonably bright surface. It should not be necessary to add metal to solution if sufficient anode surface is employed. To the contrary, if too much anode surface is used the metal content will have a tendency to increase.

Work may pass through the plating solution at a low current density and receive a dull blue-gray deposit, whereas the same load if run through at a higher current density would obtain a bright silvery deposit. The majority of parts when properly racked so that projections towards anodes are minimized, can be run through plating tank at a current density of 25 to 30 amperes per square foot with the above results. A 3000 ampere 6 volt motor generator set is used on a 2800 gallon tank of solution.

The plating solution is operated at room temperature with a single steam pipe on bottom of tank to raise temperature on cold mornings when it is inclined to fall below the desired figure.

The length of time work remains in plating tank is six minutes and the bath is operated with six ounces free cyanide, two ounces metal, and five ounces carbonates. The first water tank following the plating solution is used to catch the drag out, and this rinse water is used to raise the level of plating solution when necessary, the work remains in this tank twenty seconds. The parts should be racked in such a way that as little as possible of the solution is carried out of the various tanks, at the same time considering how the parts will be best plated.

Next in line on machine is a 300 gallon tank of running cold water in which the work remains ten seconds, after it passes through this rinse tank it is lowered into an empty 300 gallon tank equipped with four sprays which play cold water upon the work for ten seconds as it is being lowered into and raised from the tank. This spraying of clean cold water upon the work is a sure way of having all work pass through water that is in no way contaminated with plating solution.

From the spray tank it is finally submerged for thirty seconds in the 400 gallon tank of hot water. This water is kept boiling and contains enough of a potassium soap to give it a milky color.

Following the hot water rinse the parts are thoroughly dried by running them on a conveyor through an oven kept at 350 degrees F. Time of drying is four minutes. In spite of this oven drying the work would stain badly if left packed close together in a moist atmosphere or if the humidity were high.

We began to have considerable work returned for replating because of becoming stained, tarnished and discolored, this in spite of the fact that the parts had passed a rigid inspection and were o. k. when leaving the plating department. It appeared on parts packed and tested close together in trucks and boxes. Unlike a tarnish on silver plated articles which appears where air comes in contact with metal this was just reversed, where air circulated freely the cadmium plate was o. k. but where parts lay close together and air could not circulate we would have a sharp and distinct outline of the shape of the part in a dark brown stain or tarnish. This trouble sppeared mostly in hot humid weather.

We could not determine what caused this troublesome condition, so we had to discover some cure for it in order not to stop production. It was noted that parts which went directly into the assembly line never showed this discoloration, but it was impossile to put all immediately into the assembly line so they were piled as loosely as possible in trucks and boxes to allow air to circulate freely. It was rather inconvenient to pack and pile work loosely as our storage space was limited and we ran out of trucks and boxes.

We consulted Mr. Soderberg of the Udylite Process Company, who had been investigating this same condition and his explanation was that, as cadmium was susceptible to discoloration in the presence of ammonia, these stains were caused by ammonia generated in the plating solution and absorbed by the metal while it was being plated. When parts were packed immediately after coming from plating solution the ammonia was not removed from pores in metal. (Rough and porous steel seemed to stain more readily than smooth cold rolled stock.) As long as the air had a chance to circulate freely in and around the various parts we experienced no difficulty, but just as soon as parts were stored in moist, warm air they would discolor.

Working on the assumption that a protective film of some kind might prevent this discoloration, we tried a whale oil soap solution in final hot water rinse, but we had no success with that. Lacquering was not considered on account of soldering which had

to be done while parts were being assembled. It seems that the condition spoken of does not exist in new plating solutions, at least we did not experience it until cadmium plating solutions were several years old.

We finally found a remedy in a certain potassium soap cleaner used on aluminum, tin and their alloys. This was used in the final hot water rinse at a strength of 1/8 ounce per gallon or just enough to give the water a light milky color. Just what action takes place to cause this particular soap to give results I have been unable to ascertain. We were satisfied that it gave results. The slight film it leaves on the work did not interfere with subsequent operations. After work passes through this hot soap water and then through dryer it has a clean and clear appearance and does not stain even when packed close together in boxes and trucks.

Our barrel units for cadmium plating are not full automatic but they handle small parts very efficiently and economically. Each unit is composed of six horizontal cylinders thirty inches long and twelve inches in diameter; the plating tank is large enough to acommodate the six cylinders at one time and contains 600 gallons of solution. Two water rinse tanks are located at one end of plating tank and each one accommodates one cylinder at a time, cylinder is put in gear and makes electrical contact when submerged in plating tank and also rotates when submerged in water rinse tank. Next in line to rinse tanks is loading and unloading stand. When unloading, the cylinder is uncovered and inverted, this drops load into chute conveying work to tote pans which transfer parts to dryer. Motor generator set is located at opposite end from loading and unloading stand. An electric hoist travels over the length of unit for raising and lowering cylinders.

All the cleaning and pickling is done in a separate unit over which a chain hoist travels on an I beam loop reaching the plating and driving equipment as well. All parts to be barrel plated are cleaned and pickled in perforated sheet steel baskets, riveted and welded together. Baskets of this type and construction give better service than the wire mesh baskets which usually pull apart long before they are worn out, especially when they carry heavy loads. I find these sheet steel baskets more economical than the ones made of acid resisting metal; they may have to be renewed oftener but the cost is so much less that it

really pays. These baskets are used for handling both steel and brass parts before cadmium plating. For brass parts that are to be bright dipped we use perforated sheet aluminum baskets, transferring from steel baskets just before going into bright dip.

The cleaning and pickling of screws, bolts, nuts, washers and small parts fabricated in press room is as follows: They are loaded into sheet steel baskets 12 inches in diameter and 16 inches high, carrying as much as 100 pounds at one load, this size load is possible when a chain or electric hoist is used. Unless exceptionally free from grease and oil, all parts are washed in a tank of solvent or low grade kerosene; this I find is good practice as it gives a better and quicker job of cleaning and saves the first hot cleaner. After draining they are placed in the first or heavy duty hot cleaner. This is followed by a 50% muriatic acid pickle as some parts have a heavy scale and some are rusty.

After rinsing in cold water they pass into the second hot cleaner to remove any grease that might have been picked up in pickle, they are rinsed and placed in a storage tank containing a four ounce per gallon solution of sodium cyanide where they remain until ready to be loaded into plating barrels. The cadmium plating solutions were operated with approximately three ounce metal and eight ounce free cyanide per gallon until we started plating various springs, then we found it advisable to reduce the free cyanide content to about four ounces per gallon to avoid hydrogen embrittlement.

The pickling operation on springs is just as important. For our purpose we used a 10% sulphuric acid pickle containing six ounces Bichromate of soda per gallon. By using this pickle and keeping the free cyanide content down in plating solution we have had no trouble with hydrogen embrittlement on springs of various sizes and shapes both flat and spiral. Depending upon the condition of the springs we sometimes roll them in a barrel with sand or pumice stone to remove loose black smut which is sometimes left there by the pickle. Where time will permit, a soaking over night in a four ounce per gallon sodium cyanide solution will put them in condition to plate clean and white both inside and out. This to be used in placing of rolling or tumbling. (Applause).

CHAIRMAN SLATTERY: Is there any discussion of this paper?

MR. MEYER: May I ask Mr. Greenwald in connection with that warm cyanide dip that you use preceding the cadmium plating, what temperature is that operated at?

MR. GREENWALD: One hundred and ten degrees Fahrenheit.

MR. MEYER: Is that used continuously or do you use it, say, for a few months and then have to dump it?

MR. GREENWALD: We have to dump it occasionally.

MR. MEYER: Do you notice as you use it for some period of time that you begin to get a deposit on the work?

MR. GREENWALD: No, on the contrary, it comes out clearer. Where you get a deposit like that it might be what we found in the first tank. You get it in the first tank. It was always used with the direct current and we always got a clear surface.

MR. GUSTAF SODERBERG: Mr. Greenwald brought out one fact which is very important, namely, that we get so many different kinds of materials going through. We have sold some full automatics lately and you are always up against the price proposition to keep the size of the full automatics down to a very minimum to get the lowest price on them. It think sometimes the platers can help a great deal if they realize that you can't squeeze a full automatic so very far trying to make a full automatic with one minute alkaline cleaner and dip in acid, when it may work on the kind of work you happen to have right at the moment, but a little later you may get the worst grease condition. You may get a little more scale and you are very badly off. The cyanide dip prior to the plating operation, I think, has saved many situations and should never be left out of a full automatic machine. I know the platers are not generally buyers of full automatic machines, but they are the ones who are running into the trouble when we have it. Bigger and better full automatic machines are what I want to talk for at this moment. Thank you.

MR. GARTLAND: I would like to ask Mr. Greenwald the amount of deposits. Six minutes is the time limit. You get about two tenths.

MR. GREENWALD: From two to two and one-half per ten thousandths.

SPECIFICATIONS FOR CHEMICALS USED IN CLEANING METALS

By Edward B. Sanigar

The Electrodepositors' Technical Society (London, England) appointed a Standards Committee some time ago to consider specifications in electroplating work. In their report, recently made public (*J. Electrodepositors' Tech.* Soc. **8,** Preprint No.

3, pages 10-12 (1933) it is stated that their work has fallen into three main sections. These, and the progress attained, are given as follows:

1. *Cleaning Chemicals.*

   The Committee has considered the various substances used for metal cleaning, and gives a report (see below for summary) intended to help the plater in selecting his materials.

2. *Liaison with the British Standards Institution.*

   Representatives of the Committee are sitting on three British Standards Institution sub-committees dealing with platers' chemicals (nickel salts and anodes, and cyanides), containers for acids, and electrochemical definitions. Good progress is reported in these fields but no report is made.

3. *Proposed Standardisation of Electrodeposits.*

   The Committee, after considering the possibility and advisability of formulating standards for electroplated coatings, feels that this matter requires much consideration before any decision can be reached, and they are not prepared to make any recommendation at present.

Report on Metal Cleaning Chemicals

It is pointed out that the purity of the material is usually not of prime importance when the substance is used for metal cleaning only, and that sometimes some of the impurities may be beneficial. For this reason the Committee has not formulated exact specifications except for Trichlorethylene. Attention is, however, drawn to the fact that low grade chemicals, though working satisfactorily, are uneconomical to buy since the price charged for them is usually in excess of that for the amount of desired chemical they contain.

The Committee, realizing that the plater requires to replenish his solutions with small amounts of chemicals from time to time has endeavored to recommend the most satisfactory grade of chemical for general purposes.

A timely word of advice is given to the plater, *viz.*, "The plater should remember that in substituting pure chemicals for lower grade ones, he may not get the same results unless he adds the necessary materials. Thus, pure caustic soda alone is not suitable for removing mineral grease. Some caustic soda contains a large proportion of carbonate which assists the cleaning action, and the plater should decide by enquiring the prices of the pure materials concerned, whether it is not more economical for him

to make his solutions with these than with the lower grade chemicals. Caustic baths that have been worked for some time are often found to be superior, due to the formation of a little soap from the greases removed. They can, however, be artificially aged by boiling with a small quantity of animal fat."

Specifications are given for the following chemicals:—

1. *Caustic Soda*

The "Flake" or "Petal" Caustic Soda, 98% is considered the most economical, and should contain 97-98% NaOH. The principal impurities are sodium carbonate, sulfate and chloride, while silica and iron may also be present. Lower grades are not considered economical for cleaning solutions, nor is pure caustic soda (containing 99.5% NaOH), although this latter may be used for plating solutions.

If required for replenishing solutions it should be bought in containers that can be easily closed and made air-tight since it readily absorbs moisture from the atmosphere. The hundredweight drum of caustic soda (in which the caustic has been poured into the drum while molten and has solidified into a solid mass) is not considered serviceable in most instances.

2. *Sodium Carbonate* (*Soda ash*)

The grade called "light ash" is considered most suitable. This should contain about 57% Na_2O, the principal impurities being sodium bicarbonate and chloride, and iron. It is pointed out that soda crystals are not economical as they contain a large amount of water (of crystallization).

3. *Sodium Silicate.*

The grade containing about 30.5% SiO_2 and 9.5% Na_2O, with a density of 84° Twaddell is favored as being most economical and most easily handled.

4. *Sodium Phosphate* (*Trisodium Phosphate*)

The Committee found sodium phosphate ($Na_3PO_4.12H_2O$) apparently sold in one grade only, practically pure although small quantities of sodium chloride and sulfite may be present.

5. *Caustic Potash*

"Broken" potash is advised as being most easily handled and most generally suitable. This should contain about 89% KOH, the impurities being carbonate and chloride. Like caustic soda, it absorbs moisture and should be kept in air-tight containers.

6. *Potassium Carbonate*

This, it is stated, is usually supplied in a grade containing about

96-98% K_2CO_3, the principal impurities being potassium chloride and sulfate, and sodium carbonate.

7. *First Sorts English Potashes*; *American Potashes*

Of these, the report says "These two materials contain about 45% each of caustic potash and carbonate of potash, with some 10% caustic soda. This mixture is marketed in this form, and it is suitable for cleaning purposes."

8. *Trichlorethylene*

It is pointed out that trichlorethylene is finding increasing use in cleaning, especially by the vapor process, and that it is essential it be pure and, particularly, free from acid since otherwise the work will be etched. The following specification is suggested:-

Boiling range. — 85.5-87.5° C. (760 mms.).
Phosgene — Absent.
Specific gravity at 15° C. — 1.47-1.48.
Water content. — Less than 0.02%.
Acidity. — Not acid to Methyl Orange or Phenol Phthalein.
Color. — Free from all color.
Free Chlorine. — Absent.
Residue on evaporation. — Less than 0.001.

9. *Carbon Tetrachloride*

Carbon tetrachloride (CCl_4), apparently, is supplied in one grade, which should conform approximately to the specification given below:-

CCl_4. — 99.9%.
Sulfur compounds. — Less than 0.03%
Acidity. — Absent.
Moisture. — Absent.
Boiling point. — 76.8°C.
Specific gravity. — 1.600.

This completes the report. In presenting this summary to members of the American Electroplaters' Society it is felt that, not only will it be of interest to them to know what is being done by their sister society in England, but that it will be of value to them in their profession.

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ABSTRACT SECTION

EDWARD B. SANIGAR

These abstracts are mostly adapted, by permission, from "Chemical Abstracts", the references to that publication being given in the form — *C. A.*, **27,** 3402 (1933) *i. e.*, Chemical Abstracts Volume 27, page 3402 in the year 1933. The name appearing at the end of the abstract is that of the abstractor. Abbreviations for scientific journals are those used by "Chemical Abstracts" (see *C. A.* **25,** 6019 (1931). E. B. S.

Use of bimetallic anodes in the electrodeposition of alloys. C. BECHARD. *Compt. rend.* **196,** 1480 (1933).—With brass anode and other conditions regulated to give a deposit rich in copper (about 80% Cu) the supply of copper from the brass anode does not compensate for the copper deposited. Because of so-called "bath inertia", the composition of the deposited alloy undergoes cyclic variations. The same phenomena are observed when separate copper and zinc anodes are used, but the variations in composition are much greater. In general, the amplitude of these variations is greater as the area ratio of anodes deviates from the metal ratio of the alloy most favorably deposited under other bath conditions. When the initial electrolyte is potassium cyanide, the first effect is the attacking of the copper and the zinc anodes in proportion to their relative exposed areas. The resulting concentration of the electrolyte then determines the composition of the alloy first deposited. Once a deposit of alloy occurs, the cyclic phenomena described above recur. The controlling interdependent variables are: (1) ratio of rate of solution of the anode metals, (2) composition of solution and (3) composition of alloy deposited.

C. A., **27,** 4176 (1933). R. H. CHERRY.

Coloring of copper and brass. M. GROSSIEAUX. *Cuivre et laiton* **6,** 35 (1933).—Several recipes for cleaning and pickling brass with sulfuric acid, or sulfuric with chromic acid, or nitric acid, or a mixture of sulfuric and nitric acid are given. Copper can be colored green ("patina") by an ordinary salt solution of 25 g./l. which is repeatedly applied to the surface until the desired color is obtained; the same effect can be brought about by a solution of 1 lb. ammonium chloride in about 20 liters of water. With a solution of 5 liters water (at 70°C.), 4-8g. potassium sulfide and 10 drops ammonia (26%), the metal assumes successively the tints brown, bronze-red, blue-black, black; the treatment is stopped when the desired tone is obtained. Blue or black on brass, according to the duration of immersion, is obtained in a solution of 5 liters of water (at 80° C.), 250g. sodium thiosulfate and 30-60g. lead acetate. Brass is also blackened by 68 parts of ammonia (specific gravity 0.91) and 10 parts basic copper carbonate in which solution the metal is vigorously moved about. Details of treatment are given.

C. A., **27,** 1599 (1933). M. HARTENHEIM.

Coloring brass with solutions. GEORG GROSS. *Metallwaren-Ind. u. Galvano-Tech.* **30,** 455 (1932).—Rolled brass strips containing 63% copper were treated with a solution of 124g. sodium thiosulfate ($NA_2S_2O_3.5H_2O$) and 38g.

lead acetate (Pb $(CH_3COO)_2.3H_2O$) dissolved in 1 liter of water. By variations in time and temperature there was produced almost the entire color scale.

C. A., **27**, 935 (1933). CURTIS L. WILSON.

Chromic acid poisoning. R. W. GRAHAM. *Can. Med. Assoc. J.* **27**, 645 (1932).—A patient engaged in chromium plating for 2½ years developed excessively troublesome cough and hoarseness. There was loss of sleep and weight with anorexia (loss of appetite. E.B.S.) and fatigue and nose bleeding. The nasal septum was perforated. Removal from the fumes, inhalations of Frair's balsam, free elimination from the bowels and bladder, together with an iron tonic, resulted in complete recovery.

C. A., **27**, 909 (1933). G. H. W. LUCAS.

The effect of hydrogen peroxide in the chromium-plating bath. E. RAUB and K. BIHLMAIER. *Mitt. Forschungsinst. Probieramt Edelmetalle* **6**, 85 (1932/33).—Experiments have shown that hydrogen peroxide can be used with advantage as an addition to chromium-plating baths in all cases where an increase in the content of chromic chromate is desired, as it reacts almost immediately with chromic acid to form chromic chromate. Chromic salt increases the range of bright chromium-plating as long as it does not exceed a certain amount with respect to the chromic acid. The best ratio of chromic acid to sulfuric acid does not greatly depend on the content of chromic chromate; the throwing power of baths very rich in chromic acid is greatly improved by increasing the sulfuric acid content to 1.5-2.2% of the chromic acid. The bath resistance is not perceptibly influenced by a content of chromic chromate up to 7-10% of the chromic acid. The test results are given in curves.

C. A., **27**, 1276 (1933). M. HARTENHEIM.

Protection of steel against corrosion by outdoor atmosphere by electroplating with nickel, chromium, and nickel plus chromium. P. JACQUET. *Bull. soc. franç. électriciens* **2**, 631 (1932); Chimie et industrie **28**, 1351.—The corrosion tests were carried out exclusively by exposure to atmospheric agents. The protection of the steel by electrolytic deposits of nickel became appreciable only above 700mg. nickel per sq. dm. (0.00032 inch thick). The method of applying the deposit did not seem to have much effect on the corrosion. Nickel deposited at low c.d., however, appeared to give slightly better protection than when deposited at high c.d. Chromium applied directly on steel up to a thickness of 0.0002 inch or 0.005mm. (340mg./sq.dm.) did not afford any protection. The protective action of nickel can be improved upon by covering it with a coating of chromium of suitable thickness which, in turn, depends on the thickness of the nickel coating; with less thn 500mg. nickel/sq. dm., the weight of the chromium should be at least 45mg. (equal, from the above figures, to approx. 0.000027 inch. E.B.S.). From the standpoint of appearance, polished nickel plus chromium is much superior to polished nickel alone. A coating of nickel+copper+chromium affords much better protection than nickel+chromium, but rapidly acquires an unsightly appearance, which may be avoided by using a coating of nickel+copper+nickel+chromium, which is the one most used at the present time. A coating of nickel+cadmium+chromium affords excellent protection against rust, but gives rise to a superficial scaling of chromium; nickel+cadmium+nickel+chromium coating is to be rejected for the same reason, and gives even worse results. (Compare this

abstract with the Tentative Conclusions published by The Research Committee, A.E.S. in The Monthly Review for January 1933, pages 5-9. E.B.S.). *C. A.*, **27**, 1276 (1933). A. PAPINEAU-COUTURE.

Chromium-plated culinary articles, cutlery, etc. German patent No. 567,307. December 18, 1930. Vereinigte Deutsche Nickel-Werke A.-G. vorm. Westfälisches Nickelwalzwerke Fleitmann, White and Co. The chromium layer is deposited on a layer of nickel-copper alloy containing more than 25%, preferably 45-70%, of nickel. The resistance of the chromium layer to acid foods is thus enhanced. *C. A.*, **27**, 1283 (1933).

Chromium-plating the bore of gun-barrels. U. S. patent No. 1,886,218. November 1, 1932. JOHN M. OLIN and ALFONS G. SCHURICHT (to Western Cartridge Co.). Chromium-plating is used for finishing gun-barrels, or for restoring the caliber of re-bored guns. Claim is made generally to gun-barrels with chromium-plated bore. Apparatus for plating is described. *C. A.*, **27**, 1283 (1933).

Chromium-plating. British patent No. 360,649. October 28, 1930. Siemens and Halske A.-G. A pre-determined degree of hardness is imparted to steel articles of large surface relative to mass, e. g., needles, by heating them, after chromium-plating, in non-oxidising, preferably liquid, media to 100-300° C. and then rapidly cooling. *C. A.*, **27**, 913 (1933).

Chromium-plating. German patent No. 563,882. January 13, 1927. I. G. Farbenind. A.-G. Chromium-plating to resist corrosion and heat is produced by giving a metal an intermediate nickel or cobalt coating, a final galvanic coating of chromium, and heating to a high temperature in a neutral atmosphere so that the two coatings diffuse into each other without melting. Temperatures between 1100-1300° C. are used. Examples are given. *C. A.*, **27**, 913 (1933).

Chromium-plating. U. S. patent No. 1,890,633. December 13, 1932. ELMER J. WALTZ. An electrolyte for chromium deposition contains chromic acid 18 oz. and sodium cyanide 1.5 oz. per gallon. *C. A.*, **27**, 1579 (1933).

Coating molded articles with metal. British patent No. 363,432. September 27, 1930. JOSEPH GLOSTER, LTD., and LEONARD J. GLOSTER. The article is molded from a mixture of a synthetic resin or phenol-formaldehyde condensation product (25-50%) and an electrically conductive material, e. g., carbon (50-75%), in a finely divided state, and a coating of metal is electrodeposited on the finished molding. *C. A.*, **27**, 1579 (1933).

Bath for electroplating with tungsten. U. S. patent No. 1, 885,701. November 1, 1932. COLIN G. FINK. A bath is used comprising an aqueous solution of tungstic acid and an alkali metal carbonate, such as sodium carbonate, and having a pH of about 12.5. U. S. patent 1,885,700 relates to a bath formed by adding tungstic acid and an alkali metal compound such as caustic soda to water so as to give a pH of about 12. U. S. patent 1,885,702 specifies adding a trace of nickel to an acueous tungstate plating bath, the nickel serving as a cathode depolariser. Apparatus is described. Thorium, titanium, zirconium or aluminum may be plated from similar baths. *C. A.*, **27**, 913 (1933).

Flexible razor blades with cutting edges of electrodeposited tungsten or cobalt-chromium alloy. British patent No. 348,336. April 12, 1930. C. H. HUMPHRIES. Various details of manufacture are given.

C. A., **27**, 1283 (1933).

The Eloxal process (anodic oxidation of aluminum). HANS SCHMITT. *Metallwirtschaft* 11, 689 (1932).—The Eloxal process consists of producing anodically an oxide coating on the surface of articles made of aluminum or aluminum alloys. The electrolyte consists of an oxalic acid solution with the addition of a strong mineral acid. By the proper choice of concentration of the solution, temperature, c. d. and voltage, the structure and properties of the oxide coating can be varied to suit several purposes. For wire, strip and foil an elastic film can be produced which will withstand bending and has good electrical insulating properties. If desired it can be made sufficiently porous to absorb Bakelite varnish, this resulting in high electrical resistance. A very hard coating can be produced which is used on screws, valves, gas cocks and hose couplings. Another application is for vessels which are to resist the corrosion of fruit juices and wine. For this purpose the vessels are sometimes impregnated with linseed oil and then baked. This type of coating has no effect on the flavor of the liquids. (See the Monthly Review for April 1933, page 47, for an article on "Alumilite", also a process for the anodic oxidation of aluminum. E.B.S.). *C. A.*, **27**, 908 (1933). C. E. MACFARLANE.

Surface protection of light metals. J. FEISER. *Umschau* **36**, 428 (1932); *Met. Abstracts* (in *Metals and Alloys*) **4**, 104.—After mention of paint coatings, galvanic coatings and mechanical plating, anodic oxidation is discussed, and attention is directed to the Eloxal method of the Vereinigte Aluminum Werke. The bath consists of oxalic and chromic acids. A film of 0.02-0.03 mm (0.0008-0.0012 inch) thickness is secured, the properties of which can be varied between a hard brittle oxide, almost as hard as corundum, or a less hard and elastic oxide. Stress is laid on the fact that the Eloxal layer is a perfect insulation. The chemical resistance can be improved by impregnating the film with paint coatings which may be any color. Aluminum pistons impregnated with fat did not display any noticeable sign of wear. Eloxal films show a greater resistance to wear than chromium-plated surfaces.

C. A., **27**, 4514 (1933). G. G.

Oxide layers on aluminum. French patent No. 736,918. May 10, 1932. Vereinigte Aluminum Werke A.-G. Layers of oxide are produced on aluminum or its alloys electrolytically, the electrolyte being projected, e. g., by a spray pistol, onto the object placed as the anode, the electrolyte being connected by appropriate means to the negative pole of the source of current.

C. A., **27**, 1285 (1933).

Oxide layers on aluminum. French patent No. 723,299. September 24, 1931. Vereinigte Aluminum Werke A.-G. Oxide layers on aluminum are made elestic by a treatment with alkaline solutions or solutions of salts of feebly alkaline or acid reaction, of potassium chlorate, potash alum, metallic soaps or wetting agents. *C. A.*, **26**, 4141 (1932).

The Bonderite process. FR. KOLKE. *Oberflächentech.* **10**, 127 (1933).—The Bonderite process is a method to produce quickly on iron or steel surfaces a phosphate layer which protects the metal from corrosion and which can be

coated subsequently with paints, oils or other materials; the phosphate layer is produced to supply a better bond for the adherence of the coat. The objects to be bonderized are suspended for 8-12 minutes in a 3% solution of manganese phosphate and a copper salt at 98° C; the parts are then cleaned with water, dried and are ready for coating. An installation for treating automobile parts in great quantities is described. The corrosion resistance of bonderized iron can still be increased by heating the parts up to 300-350° C. While this process is mainly intended for a rapid production of the phosphate layer for a better adherence of the coating, it is not quite equivalent to the Atrament and Parkerizing processes which are intended to increase the corrosion resistance.

C. A., **27**, 3903 (1933). M. HARTENHEIM.

Phosphoric acid as derusting and rust-preventing agent. BÜTTNER. *Tek. Tid. Uppl. C, Kemi* **63**, 45 (1933).—The chemical reactions involved in the pickling of iron in phosphoric acid are discussed. The disadvantageous hydrogen generation which takes place has been practically eliminated by the use of a 3.5% soln. of *atromentol*. This new compound consists of a mixture of primary metal phosphates with a small but fixed, amount of phosphoric acid. *C. A.*, **27**, 4515 (1933). D. THUESEN.

Electrolytic deposition of zinc from acid solutions. HISASHI KIYOTA. *Mem. Coll. Sci. Kyoto Imp. Univ., Ser. A.*, **15**, 301 (1932).—Baths of zinc sulfate in a solution 0.1 *N.* with respect to free sulfuric acid, and in sodium sulfate solution 0.1 *N.* with respect to acetic acid were tested. A platinum dish was used as cathode and a platinum disk rotating at about 1500 r. p. m. as anode. Deposits from the sulfuric acid solution were not satisfactory. With the acetic acid bath smooth coatings were obtained. The acid concentration varied with the amount of zinc present as follows: 0.15-0.21 *N.* for 0.5g. zinc in 125cc. of solution, 0.21-0.27 *N.* for 0.3g. zinc, and 0.27-0.33 *N.* for 0.1g. zinc. Sodium sulfate and ammonium sulfate, when less than 0.15 *N.*, did not interfere. *C. A.*, **27**, 909 (1933). CURTIS L. WILSON.

Zinc and aluminum anode for the electrodeposition of zinc U. S. patent No. 1,888,202. November 15, 1932. ARTHUR K. GRAHAM (to Hanson-Van Winkle-Munning Co.). Anodes are formed containing zinc together with aluminum (suitable in the proportion of about 0.25-5%), which serves to reduce sludge formation and to improve operation in various other respects. (See Monthly Review, September 1933, page 38. E.B.S.).

C. A., **27**, 1283 (1933).

Zinc-Aluminum-Mercury anode for the electrodeposition of zinc. U. S. patent No. 1,887,841. November 15, 1932. GEORGE B. HOGABOOM (to Hanson-Van Winkle-Munning Co.). Zinc anodes which may contain less than 5% aluminum and less than 1% mercury are used. (See Monthly Review, September 1933, page 38. E.B.S.). *C. A.*, **27**, 1284 (1933).

Influence of pickling operations on the properties of steel. H. SUTTON. *Rolling Mill J.* **5**, 275 (1931); *Met. Abstracts (in Metals and Alloys)* **3**, 306.—The pickling of iron and steel usually produces brittleness. The changes in physical properties are attributed to the presence of absorbed hydrogen. The acid cleaning of low-and medium- carbon steels is not detrimental, and the brittleness produced is but temporary. In 10% sulfuric acid soln., or in an equivalent soln. of acid sodium sulfate ($NaHSO_4$), hydrochloric or

hydrofluoric acids, the degree of brittleness increases also with temperature of pickling up to 122° F. This embrittling effect disappears gradually at room temperature and more rapidly at higher temperatures. A heat-treated nickel-chromium steel strip, however, displays very little brittleness after pickling. Electrolytic pickling in sulfuric acid soln. results in severe embrittlement, which disappears on heating to 212° F. Electrolytic pickling in caustic soda soln., sodium cyanide or a mixture of sodium carbonate and bicarbonate produces but a slight embrittlement. Cracks may develop during pickling in steels that have been subjected to strain and insufficiently annealed. The addition of 2% pyridine or quinoline to an acid pickling bath may reduce the embrittling considerably. Hydrogen brittleness may be imparted to steel by the operations of electroplating. This is a more permanent form of brittleness and requires more vigorous attention than does the brittleness resulting from acid pickling. *C. A.*, **27**, 1850 (1933).

Electrolytic cleaning of metals. U. S. patent No. 1,917,022. July 4, 1933. THOMAS E. DUNN (to Bullard Co.). Organic dirt is removed from metallic parts by subjecting them as anodes to electrolytic action in an alkaline electrolyte containing phosphate and metallic ions including lead, tin, zinc or cadmium which combine with the oil or grease in the dirt to form a metallic soap. *C. A.*, **27**, 4489 (1933).

Application, structural peculiarities, and properties of sprayed metal coatings. H. REININGER. *Metallwaren-Ind. u. Galvano-Tech.* **31**, 89, 110, 130, 174, 194, 213 (1933); cf *C. A.*, **27**, 3179 (See below. E.B.S.).—As the adherence of the coating depends entirely upon adhesion without alloying, sprayed metals should be applied on surfaces roughened by either sand blast or pickling; surfaces already rough, such as cast iron, brass castings, cardboard, porous ceramic ware and wood, are immediately suitable. The microstructure is characterised by heaps of metallic grains, 0.01 - 0.15mm. in diameter, which have solidified from the molten state. Only in the case of low-melting metals like lead and tin is the heat of bombardment sufficient to remelt the metal layer. Adherence of the heaps is due not to welding but to surfaces pressing against each other. Pores and oxide layers are noted. Sprayed layers of tin, zinc, bronze, brass, aluminum, lead and copper are less dense than even the molten metals. Dense layers are obtained by light rolling or buffing with a steel brush. Annealing likewise improves the density and the covering and adhering properties. *C. A.*, **27**, 4515 (1933). CURTIS L. WILSON.

The essential characteristics of sprayed metal coatings. H. REININGER. *Z. Metallkunde* **25**, 42,71 (1933).—A brief review of the production and usefulness of sprayed metal coatings. The characteristics of various sprayed coatings are briefly described, and their structure illustrated by low-magnification photographs. *C. A.*, **27**, 3179 (1933). R.F.M.

The anodic behaviour of cobalt. KONRAD GEORGI. *Z. Elektrochem.* **39**, 209 (1933).—The influence of c.d., anion, pH, and temperature on the anodic behaviour of cobalt was investigated, and is compared with the corresponding measurements of nickel (See following abstract E.B.S.). The anion of the electrolyte has a strong influence on the passive state of cobalt, as with nickel, the potential increasing with the size of the anion for the same solution rate. No definite relation exists between c.d. and current yield of cobalt-

ions. Passivity increases with pH, but temperature shows no analogous effect. Müller's theory of passivity applies to cobalt, with the assumption of a superoxide film at low c.d. *C. A.*, **27**, 4486 (1933). ALLEN S. SMITH.

The anodic behaviour of nickel. K. GEORGI. *Z. Elektrochem.* **38**, 681 and 714 (1932).—From a comprehensive study of nickel anodes in *N* solns of nickel chloride, bromide, sulfate, perchlorate and phosphate ($Ni(H_2PO_4)_2$) at various pH values and temperatures, and with various surface conditions, it is concluded that the theory of Müller (cf. *C. A.* **26**, 3171 (1932)) applies, together with the assumption of a saturation current or a superoxide film.
C. A., **26**, 5853 (1932). CURTIS L. WILSON.

Metal ribbons. French patent No. 746,154. May 23, 1933. Allgemeine Elektricitäts-Ges. Ribbons of metal, particularly iron, are made by depositing electrolytically a layer of the metal on a horizontal cylinder rotating in a bath in which it forms the cathode, the ribbon being continuously removed from the cylinder and passing out of the bath. *C. A.*, **27**, 4179 (1933).

Electrolytic production of ductile iron. U. S. patent No. 1,912,430. June 6, 1933. JOHN R. CAIN (to Richardson Co.). Iron is electroplated on a cathode from an anode comprising free iron, through an electrolyte of ferrous chloride rich in iron, and the pH of the electrolyte is maintained at 1.5 - 2.5 by adding hydrochloric acid as required during the process, the electrolyte being maintained at a temperature of 95-100°C. *C. A.*, **27**, 4179 (1933).

Thin plates of iron by the electrolytic method. Japanese patent No. 93,615. November 17, 1931. KEIITI YOSIDA. A soln. of ferrous chloride and sodium chloride is electrolysed with iron as anode and metallic tin or a tin alloy as cathode. During the procedure, ferric chloride is added or chlorine gas is passed in. *C. A.*, **27**, 1284 (1933).

ABSTRACTS FROM THE EDUCATIONAL COMMITTEE

MR. T. F. SLATTERY, Chairman

The Nature of Spongy Zinc Deposits obtained by the Electrolysis of Aqueous Solutions of Zinc Sulphate — W. S. Selborn. Transaction of the Faraday Society, Vol. 29-page 825 - 1933

Experimental evidence is presented to show that the formation of spongy zinc during the electrolysis of the sulphate bath is linked up with the production of zinc hydroxide at the cathode. The hydroxide is occluded in the deposit, retarding crystal growth spongy deposits are favored by low metal iron concentration and by high current density.

Influence of the Composition and Acidity of the Electrolyte on the Characteristics of Nickel Deposits — D. J. MacNaughton, G. E. Gardam, and R. A. F. Hammond. Trans. of the Faraday Society July 1933, page 729.

In a previous paper on the "Causes and Prevention of Pitting in Electrodeposited Nickel", * pitting was shown to be due to the screening effect of bubbles of hydrogen adhering to the cathode surface. It may be caused either by surface defects in the basis metal or by some condition in the solution. Pitting in highly purified solutions was studied to observe the effect of variations in the composition and pH on the hardness, microstructure, cathode efficiency, and appearance of deposits.

(*P. J. MacNaughton and A. W. Hothersall. Trans. of the Faraday Society, Vol. 24-page 497-1928).

Solutions of nickel sulfate (240g/l) in various combinations with boric acid (30g/l) and quarter normal concentrations of potassium and chloride ions were used. Thin deposits were made for visual inspection, and thick ones for hardness tests and study for microstructure. For solutions not containing chlorides, the anode was surrounded by a porous pot containing solution with nickel hydroxide in suspension. Cathodes were sheet copper, coated with 0.005" copper deposited from an acid copper bath to cover over any surface defects. The solutions were used first at high pH, after which the pH was successively reduced by additions of sulphuric acid. The cathode current density was 11 amp per sq. ft., and the time of deposit two hours, giving a thickness of 0.0015". The cathode efficiency was measured in each run using a copper coulometer. Thick deposits were made only from solutions containing boric acid, on cathodes of hexagon mild steel rods coated with 0.001" copper. The pH measurements were colorimetric, but these were corrected to correspond to the quinhydrone electrode reading.

The buffer characteristics of the various solutions, and the changes in cathode efficiency and surface appearance with pH changes are shown by charts and graphs. In general, deposits from buffered solutions (those containing boric acid), had a matte finish, while those from unbuffered solutions tended to be lustrous or streaky, though in all cases, sound matte deposits were obtained at the lowest pH values investigated. Cathode efficiency curves show that buffered solutions are the more efficient at a given pH, and that the efficiency falls off more rapidly in unbuffered than in buffered solutions. Hardness tests showed a decrease in hardness with decrease in pH to a critical pH value. For solutions containing chlorides, further decrease had little effect. Maximum and minimum points occurred in graphs for solutions free from chlorides. In general, hard deposits were small-grained and tended to be bright, becoming larger grained and matte as hardness diminished. The presence of basic material in the deposits suggests that variations in the tendency for basic material to form with change of pH in the solution is similar to variations in hardness. This basic material is of a colloid nature and is positively charged. Thus it migrates to the cathode and is included on the crystal faces, restraining crystal growth and causing fine grained, hard deposits. The effect of the various ions on this tendency is discussed.

Pitting was observed in certain pH ranges in spite of the use of pure materials, and the copper coating on cathodes used to eliminate "basis metal pitting." Contrary to previous reports and to popular assumption, pitting was absent below pH3.0 and tended to occur in the high pH range of solutions containing boric acid and potassium chlorides, such as are in general use. Though a large number of bubbles form at low pH these detach quickly and do not cause pits. Quicker growth of these bubbles, and the agitation caused by their rise helps to account for this condition. Basic material of neutral charge consisting of flocculated colloids in the cathode film is apparently a large factor in determining whether or not the bubbles adhere and cause pits. The fact that potassium ions, and also those of sodium and lithium, reduce pitting where it otherwise occurs, while ammonium and magnesium ions have no effect corroborates this view. Chloride ions, on the other hand, stimulate pitting because of their strong deflocculating effect.

BRANCH NEWS

DETROIT BRANCH

IMPORTANT CONVENTION NEWS

The meeting of October 6, 1933 was held in the Hotel Statler. Mr. Hansjosten presiding. The minutes of the September meeting were read and approved. The report of the Committee for Date and Location of the 1934 Convention of the Supreme Society was read and accepted. It was found that the only available dates open in Detroit are June 11, 12, 13 and 14; and the location is the Statler Hotel. The Rotary Club of America have one week before the 4th and the Red Arrow Division of the Legion the other week. As the 4th falls on Wednesday that week is out entirely. We wrote the Supreme Secretary regarding these dates and in order to comply with the Constitution there will be a referendum vote taken by all the Branch Societies of A.E.S. Our secretary was instructed to write the Supreme Secretary advising that if these dates are not acceptable the Convention cannot be held in Detroit in 1934. It is therefore very urgent that the Branches take quick action on the referendum as there are other Societies anxious for these dates.

The Question Box only contained a few questions as follows:

1.—*Is vapor degreasing practical for cleaning before plating die castings?*

Ans.—Yes.

2.—*Some information of process for anodic treatment of aluminum?*

Ans.—Write the Aluminum Co. of America; also Aluminum Color Corp., Indianapolis.

3.—*Kindly have the Secretary read and interpret Article 7, section 3 of our Constitution.*

Ans.—The interpretation is plain. Anyone who can read may understand it. It seems to be the opinion of the Delegates from Detroit to the Rochester Convention that this section was voted down and has been put in the Constitution by error.

The meeting was well attended and a fine spirit of enthusiasm shown for a successful winter program as well as a successful Convention. Although the Branch can do no more work on it until a referendum vote has been taken therefore it requests the Branches to take this vote promptly. Detroit Branch is confident that if it has the Convention it will prove as successful as the one held here five years ago.

T. C. EICHSTAEDT, *Sec'y*

WATERBURY BRANCH

Waterbury Branch opened its Fall and Winter program Friday, October 13th. with a review of the most interesting topics discussed at the Chicago Convention. Delegates Wm. Delage and Wm. Guilfoyle gave an account of the proceedings at the Convention. Considerable stress was laid on the work of the Research Bureau and the condition of its treasury. A communication from Supreme President Van Derau calling attention to the necessity for quick action in the securing of more funds if the work of the Bureau was to continue, was read and after a little discussion the consensus of opinion was that the work of the Bureau, or at

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least that part now under way should be continued and in order to its willingness to cooperate voted to indorse the suggestion of Supreme President Van Derau that each member of the A.E.S. contribute one dollar to the fund and accordingly voted to donate $39.00 to the Research Fund.

The Committee on Speakers reported that for the next meeting, which takes place Friday, November 10th, the services of Philip H. Kirby, research associate of the American Brass Corporation had been secured. Mr. Kirby's subject will be one of great interest to platers, chemists and all interested in up-to-date finishing.

W. F. GUILFOYLE, *Sec'y*

ROCHESTER BRANCH

Rochester Branch held it's regular monthly meeting at the Hotel Seneca on Friday night, September 15. Meeting called to order by President Kohlmeier. Minutes of the previous meeting were read and approved as read.

The picnic committee consisting of C. Reama as chairman, Chas. Hehr and G. A. Lux reported that the picnic would be held at Ellison Park on Saturday, September 30 and said that a large turnout was expected. Geo. Scobell of the Scobell Chemical Co. then offered to donate the "hots" and rolls for the picnic. His offer was accepted with thanks. There were no other reports of committees.

The Question box was then opened and these questions were found:—

What causes acid copper to streak?

Ans.—Mr. Cameron—There are different types of streaks such as streaks which are uniform in the deposit; straight streaks and round streaks and these are all direct indications of different current conditions.

Mr. Gartlant—What really causes the streak? No doubt you have seen as the deposit keeps building up the streak keeps getting deeper and deeper?

Mr. Scobell—Will ridge keep building up?

Mr. Gartlant—No, the metal keeps building up around the streak.

Mr. Desmond—Do you get these streaks on all metals?

Mr. Gartlant—No, only steel. There is no known cause for these streaks even if bath is agitated it will not eliminate streaks. The only way we have found so far to eliminate streaking is to use fewer anodes in the bath.

Mr. Lux—Would dirty work cause streaks?

Mr. Reama—Yes; but it also appears on absolutely clean work.

Mr. Cameron—A streak will appear on any metal.

Mr. Lux—Where a point has a larger current density doesn't it explain treeing or streaking?

Mr. Desmond—When does streaking begin? At first or later?

Mr. Gartland—Right away. We found we got the nicest deposit on glass at 32 degrees F.

Mr. Desmond—If by reducing the anode surface this condition is somewhat eliminated then evidently the anode current density has something to do with this condition.

Mr. Cameron—New solution does not streak, it may tree but it does not streak. The streak is a developed contion. Any outside dirt does not affect the solution.

Mr. Cameron—Only remedy is to keep the solution filtered and this is not a complete remedy.

Mr. Hehr—Another way to overcome it is to work the solution for some time at a high current density.

Question—*Is there an anode that will give a better throwing power to your chrome solution than 6% antimony lead?*

Ans.—Mr. Kohlmeier—Yes. A 7% tin-lead does not build up a lead

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chromate as much as 6% antimony lead.

Mr. Desmond—The bath, that is it's condition, has more effect on the throwing power than has the anode.

After this discussion the meeting was adjourned.

JUDSON R. ELSTER, *Secretary.*

CHICAGO BRANCH

The regular monthly meeting of Chicago Branch was held October 14 at the Atlantic Hotel. President E. G. Stenberg presiding and all other officers present. The application of C. C. Johnson was balloted on and Mr. Johnson elected an active member. An application received from V. S. Brouse read and committee appointed on same. A letter from our National President Mr. Van Derau in regard to research, also the reply read and approved. Mr. Gilbertson brought up the matter of a class in chemistry for this year and Mr. Faint offered to get in touch with Mr. Emery the teacher and report at our next meeting. The convention chairman Mr. F. J. Hanlon read the final report on the convention. Receipts $4,619.67. Disbursements $4,122.05. Balance $497.62, which was turned over to the general fund of the Chicago Branch. The committee was then dismissed by our President E. G. Stenberg and given a vote of thanks by the entire branch for the excellent work done by them. The meeting was then turned over to our Librarian who found the following questions in the question box.

Q. 1. *Will Sodium Stannate dissolve in water, if not what will dissolve it?*

Ans. It will dissolve in water.

Q. 2. *Can a steel tank be used for a chrome tank?*

Ans. Yes. if it is heated with steam coil but heating with gas usually caused the bottom to leak.

Q. 3. *Can small steel parts be blued in a barrel, if so what solution is used?*

Ans. Many suggestions were offered but this is usually done by rolling in a hot sand barrel at about 550°. Another member stated that he was doing it in a steel drum heated by gas.

Q. 4. *Wanted. An immersion electrolytic solution to give a good black on etched Aluminum sheets, other than black nickel or the patented dye anodic treatment.*

Ans. Many suggestions offered, but no definite answer given.

J. W. HANLON, *Secy.*

ANDERSON BRANCH

Meeting called to order by the President.

Mr. Cleaver reported for the Committee on Trade Publications. The committee selected "Metal Industries" (London) and "OBERFLACHEN TECHNIK" as two publications the Branch should subscribe to in furtherance of its educational program. Action sanctioned. Mr. Minton reported for the Program Committee. In addition to its educational sessions, the Committee suggested that visits to several neighboring plants be arranged for the benefit of the members. This suggestion was enthusiastically received and Messrs. Chaney, G. S. Cole and Onksen were appointed as a committee of three to assist the Program Committee in arranging these plant visits.

A general discussion followed on means of increasing the attendance at the regular meetings. Mr. Ralph Seabury suggested that some subjects of general interest, not too technical, be presented. Also that two notices of each meeting be sent to each member, these suggestions are to be followed.

At the close of the business meeting, Mr. Ralph Seabury gave a very interesting talk on the History of Chemistry, outlining the earliest discoveries and uses of some of our commonest present-day chemicals.

G. M. COLE, *Secy.*

NEWARK BRANCH

The Newark Branch opened its Fall and Winter sessions with a bang on September 15th with a talk on Coloring of Steel by Oliver Sizelove. It was never better presented. Explaining the different rust-proof finishes such as Parkerizing, Carbona, Bar Bar and the nitrate method. The meeting was very well attended having 38 members present.

At the October 6th meeting George Hogaboom spoke on the test plates conducted by the Research Associates at Washington, D. C.

The Newark Branch arranged a trip to Sandy Hook to view the test plates there on Saturday, September 30th.

Mr. Hogaboom had with him a splendid group of samples of test plates sent him by Dr. Blum from the other locations where the test plates were exposed. It was indeed interesting to those that attended the Sandy Hook trip to view the effects of the climatic conditions at these different places. Mr. Hogaboom's talk was enlightening and brought forth many questions.

After Mr. Hogaboom's talk our Supreme President's letter was read and after some discussion it was decided to take a voluntary collection which netted a total of $27.00 and Newark Branch went on record for continuing the research work.

GEORGE REUTER, *Secy-Treas.*

BRIDGEPORT BRANCH

The Regular Meeting of the Bridgeport Branch was held in the Chamber of Commerce rooms of the Stratfield Hotel on October 6. President Al Rosenthal called the meeting to order at 8 p. m. The Sick Committee had no report and there were no applications for membership. A communication in regard to the Research Fund was read and handed over to Ray O'Conner, as was the communication regarding the Code. The Speakers Committee has selected Mr. Hogaboom to be the speaker at the next open meeting on Friday November 3 in the Stratfield Hotel, The Outing Committee made a report on the most successful Outing on September 23. The treasurer's report was read and accepted, and all bills were ordered signed and paid. The meeting adjourned at 10 p. m.

WM. FLAHERTY, *Secretary.*

ST. LOUIS BRANCH

Regular meeting of St. Louis Branch was called to order by President Bartt. Roll call of Officers showed two absent. Minutes of the previous meeting were read and approved. A letter was read from our Editor on advertising in the Review. Mr. Williams reported on the progress he had made in having Dr. Stout with us again this year. His report was very favorable. Our members can look forward to some real live meetings which will be very Educational by our Librarian F. P. Mennings. CHAS. T. MCGUILEY, *Secy.*

HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Connecticut Valley Branch, held its first fall meeting on Monday evening, Sept. 25, 1933. Past President Mr. Beloin took charge of the meeting. Minutes of the previous meeting were read and accepted. All communications were tabled until the next meeting, also bills for the first quarter per capita tax and Convention Report were tabled due to lack of funds.

There was no speaker for the evening. There was an attendance of only six members. Most of the time was spent in discussing means of larger attendance and renewed interest.

There was much discussion as to why no answer had been received from Pres. C. E. Van Derau, in connection with our petition of last June.

V. E. GRANT, *Sec'y.*

MILWAUKEE BRANCH

The regular meeting of Milwaukee Branch was held at Lipps Hall, N. 3rd and W. Highland Ave., October 12, 1933.

The meeting was called to order by President Paul Krause and was well attended. After the regular business the educational meeting was held, with Assistant Librarian Edw. Werner in charge. The topic for the evening was Electric Pickle. Mr. Pat. Sheehan who was on the educational committee gave a very interesting talk.

FRANK J. MARX, *Sec'y.*

CLEVELAND BRANCH

The Cleveland Branch held its regular monthly meeting Saturday October 7th, 1933, at Carter Hotel.

The meeting was called to order a 8.15 p. m. with President Ter Doest in the chair.

The minutes of the previous meeting were read and approved.

All bills were voted paid. Communication read from supreme President Van Derau with regard to the continuation of the research work. The Cleveland Branch is in favor of continuation of this work. but at the present time is unable to offer any financial aid.

We received the application of John H. Shope, 4416 W. 58th St. Cleveland, Ohio and suspended J. B. Heargeist and Thos. Sweeney.

Mr. Thompson our Librarian gave a demonstration of a cleaning compound and showed samples of this work. The meeting adjourned at 10.30 P. M.

W. D. SCOTT, *Sec'y.*

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HARTFORD-CONNECTICUT VALLEY BRANCH

The Hartford-Conn. Valley Branch held its regular monthly meeting on Monday evening, October 23, 1933 at the Hartford Chamber of Commerce, 805 Main St., Hartford, Conn.

The meeting was called to order at 8.30 P. M. with Past President Beloin in the chair. The minutes of the previous meeting were read and approved. All communications were read and placed on file. One bill amounting to three dollars and twenty-two cents, ($3.22) for copy of Convention Proceedings was voted paid.

The Secretary was instructed to send a special letter to President Van Derau, requesting an answer to our communication in regards to our petition made last June, within a period of ten days.

Considerable time was spent in discussing ways and means of making our meetings more interesting, so as to be able to draw a larger attendance to the meetings. We promise something quite different for the next meeting.

Meeting was attended by only ten members and was adjourned at 10.00 P. M.

V. E. GRANT, *Sec'y*

APPLICATIONS

	Branch
Lester R. Horner, 307 W. Washington St., Alexandria, Ind.	Anderson
V. S. Brouse, 7911 Elmgrove Drive, Elmwood Park, Chicago, Ill.	Chicago
Howard A. Krumerud, c/o E. R. Squibb & Sons, New Brunswick, N.J.	Newark
Cyril Hamlin, 123 Seymour Ave., Newark, N. J.	Newark

ELECTIONS

C. C. Johnson, 1124 Kern St., Waterloo, Ia.	Chicago

RE-INSTATEMENTS

Oscar Kuntz, 6519 Barlum Ave., Detroit, Mich.	Detroit

DEATHS

Harry Flanigan, died Sept 27. Newark

RESIGNATIONS

Grand Rapids—John Van Daff.
Toronto—W. E. Redfern

SUSPENSIONS

Boston—Wm. A. Laurence, Frederick English. *Philadelphia*—R. Hoenstein, M. A. Berenato, A. M. Moore, E. Ohl, W. L. Schaffer, H. C. Simmons, M. Smith, H. G. Trout. *Toledo*—S. C. Bogner. *Toronto*—E. Coles. *Cleveland*—J. B. Heargeist, Thos. Sweeney. *Newark*—L. Fowler, G. E. Miller, L. Steeber, G. F. Carlson, C. Bohler, A. Muller, F. Rickenshauser, D. Davis, H. Wait, M. Sternbach. *Chicago*—E. L. Ingram.

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BOOK REVIEW

Die Galvanotechnik (Electrodeposition) by Gerhard Elssner.

Published by Akademische Verlagsgesllschaft, Leipzig, Germany. 1933 (448 pages). (Price at present exchange about $10.00).

It may seem strange to discuss in the Review of the American Electroplaters' Society, a book published in German, a language which few American platers can read. However, those platers who can read German, and all chemists interested in plating, will find this a very interesting and valuable book.

It forms part 3 of the first volume of a "Handbook of Electrochemistry", edited by Victor Engelhardt. Naturally therefore the book is more scientific than most of the other books on plating that have, been written in English or German. In fact its greatest value will be to one engaged in research, for it contains over 500 references to papers on deposition, including many American authors. These references are especially complete on methods of measuring throwing power, and the hardness, adherence and protective value of plated coatings.

The book also contains descriptions and illustrations of apparatus used in cleaning and plating. This section gives a good opportunity to compare the mechanical progress in Germany and America.

The extensive scope of the book has made the treatment of many subjects so concise that it may not be as valuable to the practical plater as to the chemist who has access to other books and journals. For example the methods of analysis are described so briefly, that only a chemist could follow them.

The author has succeeded in his effort to bring to persons engaged in electrodeposition a complete, critical, concise summary of the scientific principles and developments in this field. W. BLUM.

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